Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Proceedings Series 2015/015

Central and Arctic Region

Proceedings for the regional peer review of the Anguniaqvia Niqiqyuam Area of Interest: monitoring indicators, protocols and strategies.

February 19-21, 2014
Winnipeg, Manitoba

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December 2015

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

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ISSN 1701-1280

Correct citation for this publication:

DFO. 2015. Proceedings for the regional peer review of the Anguniaqvia Niqiqyuam Area of Interest: monitoring indicators, protocols and strategies; February 19-21, 2014. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2015/015.

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SUMMARY

Darnley Bay is located in the western Canadian Arctic within the Beaufort Sea Large Ocean Management Area and the Inuvialuit Settlement Region. Four priority areas were identified for marine protection in Darnley Bay, by Fisheries and Ocean Canada (DFO) Science Sector. In 2010, under the *Oceans Act*, DFO Oceans program and the Marine Protected Area (MPA) steering committee nominated an Area of Interest (AOI) in Darnley Bay, referred to as the Anguniaqvia Niqiqyuam Area of Interest (ANAOI). A regional science advisory meeting was held February 19-21, 2014 at the Freshwater Institute in Winnipeg, MB, and focused on one of the four priority areas in the ANAOI, referred to as the Cape Parry Offshore Marine Feeding Habitat. The main objective of this meeting was to develop indicators, protocols and strategies that are appropriate for evaluating the Cape Parry Conservation Objective (CO): "to maintain the integrity of the marine environment offshore of the Cape Parry Migratory Bird Sanctuary (MBS) so that it is productive and allows for high trophic level feeding by ensuring that the Cape Parry polynyas and associated sea-ice habitat, and the role of key prey species (e.g., Arctic Cod; *Boreogadus saida*), are not disrupted by human activities" (DFO 2011). In addition to the main meeting objective, participants also assessed data availability for each indicator, and if the data could be used to provide baseline information to evaluate the success of the CO. A main working paper and a series of presentations/case studies provided information on indicators and protocols for monitoring the Cape Parry priority area. This meeting was conducted at the request of the Oceans Program and is part of Canada's ongoing commitment to building a national network of Marine Protected Areas.

As a result of the science advisory meeting, a series of indicators and associated monitoring protocols and strategies were developed for the ANAOI. This meeting included input from experts from DFO Science and Oceans programs, the University of Manitoba, the Fisheries Joint Management Committee (FJMC), and Paulatuk community members. These proceedings summarize the meeting discussions. Additional publications from this process will be posted on the DFO Canadian Science Advisory Secretariat website as they become available.

Compte rendu de l'examen régional par les pairs de la zone d'intérêt Anguniaqvia Niqiqyuam : indicateurs, protocoles et stratégies de surveillance

SOMMAIRE

La baie Darnley se trouve dans la région ouest de l'Arctique canadien, entre la zone étendue de gestion des océans (ZEGO) de la mer de Beaufort et la région désignée des Inuvialuit. Le Secteur des sciences de Pêches et Océans Canada (MPO) a défini quatre zones susceptibles de faire l'objet d'une protection marine dans la baie Darnley. En 2010, en vertu de la *Loi sur les océans*, le Programme des océans du MPO et le comité directeur de la zone de protection marine (ZPM) ont désigné une zone d'intérêt (ZI) dans la baie Darnley que l'on appelle zone d'intérêt Anguniaqvia Niqiqyuam (ZIAN). Une réunion de consultation scientifique régionale a été tenue du 19 au 21 février 2014 à l'Institut des eaux douces de Winnipeg, au Manitoba, pour examiner l'une des quatre zones prioritaires de la ZIAN, qui abrite l'habitat marin nourricier situé au large du cap Parry. L'objectif principal de cette réunion était d'élaborer des indicateurs, des protocoles et des stratégies appropriés pour l'évaluation de l'objectif de conservation du cap Parry, à savoir « maintenir l'intégrité de l'environnement marin situé au large du refuge d'oiseaux migrateurs (ROM) du cap Parry afin que celui-ci soit productif et permette l'alimentation d'espèces de niveau trophique plus élevé, en faisant en sorte que les polynies du cap Parry et l'habitat de glace marine qui leur est associé, de même que le rôle des principales espèces de proies (p. ex. saïda franc; *Boreogadus saida*), ne soient pas perturbés en raison des activités humaines. » Les participants à la réunion ont également évalué la disponibilité des données pour chaque indicateur et s'il était possible d'utiliser les données pour obtenir des informations de base pour évaluer le succès de l'objectif de conservation. Grâce à un document de travail principal et à une série de présentations et d'études de cas, les participants ont été informés des indicateurs et des protocoles pour la surveillance de la zone prioritaire du cap Parry. Cette réunion a été organisée à la demande du Programme des océans. Elle témoigne de l'engagement continu du Canada à la construction d'un réseau national d'aires marines protégées.

À la suite de la réunion de consultation scientifique, une série d'indicateurs a été élaborée pour la ZIAN ainsi que des protocoles et stratégies de surveillance connexes. Des spécialistes du Secteur des sciences et du Programme des océans du MPO, de l'Université du Manitoba, du Comité mixte de gestion de la pêche et des membres de la communauté de Paulatuk ont participé à cette réunion. Le présent compte rendu résume les discussions tenues lors de la réunion. Toute autre publication découlant de cette réunion sera publiée lorsqu'elle sera disponible sur le site Web du Secrétariat canadien de consultation scientifique du MPO.

INTRODUCTION

Under the Health of the Oceans initiative, Fisheries and Oceans Canada (DFO) Science is required to provide support and advice on Marine Protected Areas (MPAs) for DFO Oceans Management. Currently, this includes the identification of indicators, protocols and strategies that are to be incorporated into MPA monitoring plans. Indicators, protocols and strategies are intended to allow DFO to evaluate whether the regulatory conservation objectives (COs) are being met for an MPA. Darnley Bay is located in the western Canadian Arctic within the Beaufort Sea Large Ocean Management Area (LOMA) and the Inuvialuit Settlement Region (ISR). A portion of Darnley Bay was nominated as an Area of Interest and is called the Anguniaqvia Niqiqyuam Area of Interest (ANAOI). For the ANAOI, one of the COs is "to maintain the integrity of the marine environment offshore of the Cape Parry Migratory Bird Sanctuary (MBS) so that it is productive and allows for high trophic level feeding by ensuring that the Cape Parry polynyas and associated sea-ice habitat, and the role of key prey species (e.g., Arctic Cod; *Boreogadus saida*), are not disrupted by human activities." DFO Oceans asked DFO Science to provide advice on indicators, protocols and strategies to evaluate this CO for the region surrounding Cape Parry (≤ 15 km).

One of the co-chairs provided an overview of the housekeeping/ground rules for the meeting, the Canadian Science Advisory Secretariat (CSAS) process and guiding principles, and the expected output publications and document timelines. The Terms of Reference (Appendix 1) were then reviewed and the meeting agenda was presented and agreed upon by participants (Appendix 2). Participants at the meeting included affiliates from DFO Science and Oceans programs, the Fisheries Joint Management Committee (FJMC), the University of Manitoba, and the community of Paulatuk (Appendix 3).

A series of presentations were made to provide background and context to the ANAOI and to provide additional information about recent research and projects in the area. Following these presentations, participants identified a series of indicators, protocols and strategies for the Cape Parry Offshore Marine Feeding Habitat CO. These proceedings summarise the meeting discussions and present the key conclusions reached at the meeting. Additional publications from this process will be posted on the DFO Canadian Science Advisory Secretariat Website as they become available.

PRESENTATIONS

Presentation 1. ANAOI Background and Designation Process

Presenter: Leah Brown

Summary: A summary was presented on the background and designation process for the ANAOI. The ANAOI process started in 2008 when DFO received Health of the Oceans funding for a new MPA in the Arctic. Once Darnley Bay was selected as the general location for the next MPA, a steering committee was formed and an ecological and socio-economic overview and assessment were undertaken. After being officially signed off in October 2010, a CSAS meeting was held to identify COs and delineate the boundaries for the COs within the Darnley Bay region of interest. The CO specific to Cape Parry was accepted by the steering committee and the community of Paulatuk. The boundary associated with the CO was modified from 30 km offshore to 15 km, based on recommendations from the community of Paulatuk and the MPA steering committee. Two potential deep water harbour sites (Summers Harbour and Wise Bay) were removed from the original ANAOI boundary to ensure their availability for future use. The east side of the Parry Peninsula was included in the MPA boundary and was identified based on Traditional Knowledge (TK) and community support. In 2011, a TK workshop was held to collect more information on the east side of the Parry Peninsula to help define the CO and the boundary. In 2012, the boundary and COs were approved by the community of Paulatuk and the Steering Committee. In 2012, Natural Resources Canada completed a resource assessment for

minerals, petroleum and diamonds in Darnley Bay. In 2013, a draft cost-benefit analysis was completed and pathways of effects were developed to identify linkages between marine activities and the COs. The pathways of effects, along with expert opinion and local knowledge, were used to develop the regulatory intent. The next steps for the ANAOI will be to consult on the regulatory intent, develop monitoring indicators, protocols and strategies for the TK CO, complete the regulatory package for Ministerial approval and develop management and monitoring plans.

Discussion: DFO Oceans program reiterated the value and importance to maintain the partnership with DFO Science through the designation process, including the incorporation of existing and ongoing scientific research and, further questions related to the monitoring plan for the ANAOI.

Presentation 2. ANAOI Background and Science Advice in the MPA

Presenter: Joclyn Paulic

Summary: A summary was presented on the background and involvement of Science advice to the MPA designation process. Ecologically and Biologically Significant Areas (EBSAs) are identified by DFO Science to call attention to areas that have particular ecological or biological significance which can facilitate a greater-than-usual degree of risk aversion (DFO 2004). This includes the nomination and/or selection of an area of interest (AOI) for designation of a MPA. The selection and designation of MPAs are based on the best available scientific and local/traditional ecological knowledge, and therefore DFO Science sector is an integral part of the process. In 2008, DFO began to seek information and local interest for a new MPA in the ISR. An AOI could only be identified within an existing EBSA. The MPA Steering Committee selected Darnley Bay as the general area within which an MPA could be designated. Two EBSAs were located within Darnley Bay, Pearce Point and the Hornaday River; however, there was limited scientific information. In December 2010, Science was formally requested to provide advice in support of the identification and development of an MPA within the Darnley Bay AOI. An ecological overview report was developed, which characterized the ecology of the area, and prioritized areas within the EBSAs which meet the criteria for marine protection under the *Oceans Act*. DFO Science also provided advice on boundaries for those areas that were deemed a priority and identified one or more COs for each (Paulic et al. 2011, DFO 2011). Four areas were identified by Science for marine protection in the following order of priority:

1) Darnley Bay Nearshore Migration and Feeding Corridor,
2) Cape Parry Offshore Marine Feeding Habitat,
3) Darnley Bay Offshore Ice-edge Habitat,
4) Kelp Beds.

Advice, including the boundaries and the valued ecosystem components, were identified for each of the four areas. This information has since been adopted in the Re-evaluation of the Beaufort Sea EBSA advisory meeting held in November 2012.

From here, Science advice was provided to the Oceans Program, who then made a decision, based on the social, cultural and economic considerations, on the final AOI boundaries in Darnley Bay. This final decision included the Cape Parry Offshore Marine Feeding Habitat based on Science advice. It should be noted that Kellet Inlet and the west side of Darnley Bay are within the bounds of the AOI but are identified by traditional knowledge and monitoring indicators will not be identified for these areas at this meeting.

The conservation objective was re-iterated and it was stressed that participants at this meeting should focus on the key elements in the wording of the CO (e.g., higher trophic level feeding, associated sea-ice habitat, role of key prey species, not disrupted by human activities). By unpacking the CO further so it is more specific, the list of indicators will ideally be shorter and more focussed.

It was also noted that the February 2013 advisory meeting to assess stressors, impacts and pathways of effects for the Darnley Bay AOI could be helpful when participants are identifying indicators linked to human activities. It is important to reference the work already completed so there is a linkage to the earlier reports, but also a lot of work has taken place since the 2010 ecological overview which should also be considered (in subsequent presentations). The advice from this meeting will be used to inform and draft the future monitoring plan and to some extent the management plan for the ANAOI.

Discussions: Participants asked for clarification as to why science advice on indicators, protocols and strategies is being developed solely for the offshore Cape Parry area and not the entire ANAOI. It was explained that the CO in question relates only to the Cape Parry offshore area within the ANAOI. It was further explained that this area was changed from a 30 km radius offshore of Cape Parry to a 15 km radius offshore of Cape Parry for the final AOI boundary during a steering committee meeting.

Presentation 3. Cape Parry Offshore Marine Feeding Habitat Priority Area Monitoring Indicators, Protocols and Strategies

Presenter: Vanessa Grandmaison

Summary: A summary of the main working paper prepared for this meeting was presented by Vanessa Grandmaison on behalf of the hired contractor. The contractor proposed a suite of indicators for monitoring the Cape Parry priority area based on four main ecosystem categories identified at the Tarium Niryutait MPA indicators CSAS meeting (Loseto et al. 2010):

1) ecosystem structure and function,
2) biodiversity,
3) ecosystem health/health of key species, and
4) physical and biochemical oceanographic parameters.

Each category contained sub-categories and associated monitoring indicators. Indicators were selected based on ecological importance, the availability of baseline data, including TEK, and the feasibility of monitoring in the Cape Parry area. Each of the indicators was identified based on their ability to monitor key ecosystem components. Indicators were then prioritized by rating each indicator against established criteria. Many of the indicators can be monitored through participatory and community-based monitoring, nearshore and offshore sampling, and/or remote sensing and existing weather station data.

Discussion: A section of the working paper was dedicated to the current state of monitoring and research in the Cape Parry priority area. Participants noted that the section was incomplete and additional/current research in the area should be incorporated into the working paper. Concerns were also expressed regarding the use of research conducted in Franklin Bay as a proxy for Darnley Bay. Participants agreed that it is important to determine which situations in Franklin Bay/Amundsen Gulf act as forcing factors for the ANAOI (e.g., coastal through-flow, upwelling, etc.) rather than as a proxy for the ANAOI. It was suggested that the method by which Franklin Bay/Amundsen Gulf research is used (as a proxy or a forcing factor) should be outlined in the working paper corresponding to these Proceedings.

Presentation 4. Monitoring Beluga Health Indicators

Presenter: Vanessa Grandmaison

Summary: In a previous meeting on TNMPA indicators, a number of indicators related to Beluga (*Delphinapterus leucas*) population structure and health were identified (Loseto et al. 2010). In order to learn about their use as an indicator, their variability, and how they link to the ANAOI CO a number of

data sets were reviewed and analyzed. Although the original intent of this working paper was to rank Beluga blubber thickness as an important indicator for monitoring the Cape Parry priority area, due to low sample size this proved difficult to assess. For this reason, Beluga length was also examined, however this indicator was also difficult to identify and interpret the patterns and changes in length since Beluga caught in the ANAOI are harvested at different locations and on different dates. Thus far, there is no clear linkage between Beluga length and the Cape Parry CO; however, it has potential to be used as an indicator for monitoring the Beluga harvest. In sum, results of this work suggest that although a desk exercise to identify indicators is useful, each indicator will require testing to see if they are informative and/or functional as an MPA indicator.

Discussion: Participants suggested that based on current knowledge, Beluga enter the ANAOI to feed; however, contrary to this, Beluga harvested in this area usually have empty stomachs, similar to the TNMPA. It was noted that there has been a small but long-term decline in growth rates in both Beluga harvested near Paulatuk and those harvested in the Mackenzie Estuary, and similar results have been found in growth rate studies on Ringed Seal (*Phoca hispida*). It was further explained that it is likely more appropriate to look at Beluga and Ringed Seal growth rates than blubber thickness or length as a relevant indicator. Further to this, the relevant research question with respect to whales entering Darnley Bay is what is attracting them to the area. Participants agreed that measurements of body length and blubber thickness would not be able to explain a change in presence/absence.

Presentation 5. Monitoring Sea-Ice Features

Presenter: Oksana Schimnowski

Summary: Sea-ice is an important component of the ecosystem and a number of metrics are often used in monitoring programs. To be useful as a monitoring indicator, careful consideration needs to be given to the type of data collected, and research to solidify our understanding of associations between ice and ecosystem processes is required. Further to this, climate change variability and trends also need to be considered so that change can be partitioned between anthropogenic disturbances and climate signals.

Remote sensing can be used to gather data in a broad sense. The Canadian Ice Service (CIS) has archived Daily and Weekly ice charts and historic data. Charts are prepared daily during the navigable season and weekly when there is no navigation activity. Ice formation and freeze up dates, fracture and breakup dates, concentration and stages of melt, and duration of the open water season are easily obtained through the CIS. Average ice conditions have also been produced for the Arctic and can be obtained online from CIS; for example, 20 year average sea-ice concentrations in a given week are available. Certain metrics are more difficult to obtain via remote sensing. Snow thickness and the timing of melt onset are more complicated to derive using satellite radar systems. Although methodologies exist in the literature (Kwok et al. 2003), there are limitations to their use and application, and the uncertainties and errors that can result from their use must be well understood (e.g., level flat ice regions are more accurate). Ice metrics are currently being monitored on an Arctic-wide scale as well as regional scales to inform on climate warming and the use of metrics as indicators of change.

Direct community-based monitoring of snow and ice metrics, such as drifted areas for denning habitats or ice cracks and leads, would be required if such information is needed for research or monitoring. These observations could be gathered by local hunters on an ad-hoc basis as the Cape Parry region is frequented in winter and sometimes spring for Polar Bear (*Ursus maritimus*) hunting and trapping.

Discussion: A participant asked if it was possible to contact CIS in advance and arrange for them to provide daily ice charts in real time. The response to this question was yes. A Paulatuk community

member explained that he had intimate knowledge of sea-ice features in the ANAOI such as sea-ice break-up timing, ice leads, etc.

Presentation 6. Beaufort Regional Environmental Assessment (BREA) Program Overview

Presenter: Jim Reist

Summary: An overview of the most recent fish work conducted in and around the Darnley Bay priority area and an outline of future studies was provided. Studies were conducted to obtain baseline information on offshore marine fishes and habitats associated with the Canadian Beaufort Shelf/Slope and the Amundsen Gulf. It was determined that the species composition within the 20 m isobath was considerably different than the offshore fish assemblages, where inshore fish assemblages were primarily dominated by species such as Saffron Cod (*Eleginus gracilis*) that are tolerant of wide salinity and temperature ranges. Similarly, in terms of offshore versus nearshore fish assemblages, the western side of Darnley Bay was considered to be more marine in nature, whereas the eastern side was considered to be more mixed in terms of salinities. The plan for 2014 is to sample to 2000 m depth in the southwestern Banks Island area, using a bottom trawl. If favourable ice conditions are present, the second priority is to sample in the McClure and Prince Patrick areas. Alternate plans include re-sampling in the Cape Parry and Darnley Bay areas.

Discussion. A participant expressed the importance of long-term research programs in the ANAOI. A Paulatuk community member also expressed the importance of conducting scientific research throughout the year instead of concentrating research during the spring/summer. This participant also suggested that there should be a full time TK representative for dealing with issues related to the ANAOI, and that Paulatuk community members have an intimate knowledge of fish biodiversity and habitat use in the ANAOI.

Presentation 7. Capelin in Darnley Bay

Presenter: Darcy McNicholl

Summary: The focus of this presentation was on the life history characteristics of Capelin (*Mallotus villosus*) in the coastal Beaufort Sea area and their co-occurrence with Arctic Cod. Capelin are typically associated with sub-Arctic environments, however little is known about their ecological role in the Canadian Arctic and how it may change in a warmer Beaufort Sea scenario. In a recent Beaufort Regional Environmental Assessment (BREA) survey, 464 Capelin were collected from the Amundsen Gulf/Darnley Bay region, which also provided evidence of spawning. Researchers are investigating the extent of the dietary and isotopic niche overlap between Capelin and Arctic Cod to determine habitat use and linkages among trophic levels. Lastly, researchers plan to examine the contribution of Capelin to the diet of Arctic Char (*Salvelinus alpinus*) by examining stomach contents and energetic density between Capelin and Arctic Cod. This project also aims to provide inference for the potential for Capelin to overwinter in the Amundsen Gulf and if Beaufort Sea Capelin represent a self-sustaining population. Capelin have been observed in the stomachs of Hornaday River Arctic Char and Thick-billed Murres (*Uria lomvia*), which also feed on amphipods and Arctic Cod. Thus far, current research demonstrates a potential shift in Capelin distribution from southern waters to more northern climates and therefore a possible shift in the current ecosystem structure.

Discussion: When the CO for the Cape Parry priority area was initially created, there was an assumption that Arctic Cod would be the most important dietary component for the bird colonies in the area, which still may be true. Diet shifts in birds from Arctic Cod to Capelin (similar to those observed in Hudson Bay) could affect the reproductive success of those colonies feeding in the marine environment and possibly other ecosystem components. An increase in the abundance of Capelin in Darnley Bay will also have significant effects on the growth and distribution of Horndary Arctic Char.

MEETING STRATEGY

Participants felt that many of the proposed indicators within the working paper lacked a direct linkage to the Cape Parry CO. Participants agreed that the working paper could become a Research Document but major revisions were needed, including a new list of indicators for monitoring the ANAOI. In the meeting, participants broke down the Cape Parry CO into its key components, and a new list of monitoring indicators was created based on these elements. The resulting indicators provide information on ecosystem integrity (structure and function), marine productivity, the roles of key prey species (i.e., Arctic Cod, birds, Ringed Seal, etc.), polynyas and ice habitats, and human impacts.

A set of categories were also created by meeting participants to provide additional background information on the selected indicators. Detailed information on these categories can be found in the Science Advisory Report (SAR) and Research Document corresponding to these Proceedings. The categories chosen by participants include: data availability within the ANAOI, data availability within 100 km of the ANAOI, local/external representativeness, whether the indicator is cost effective, the potential for community monitoring (Paulatuk community members were very supportive of this idea), the monitoring method/timing/frequency, whether the indicator is relevant to the CO, the sensitivity of the indicator, and whether the indicator is informative. For the cost effective category, participants agreed to use dollar signs to represent general associated costs; where one dollar sign is equivalent to $10,000+, two dollar signs are equivalent to $100,000+, and three dollar signs are equivalent to $1,000,000+. It is important to note that although the cost associated with monitoring plans was discussed during this meeting, it did not form the basis for the selection of monitoring indicators for the ANAOI; the rough estimates were included to provide DFO Oceans with a general idea of the requirements for using each indicator.

ASSESSMENT

ECOSYSTEM INTEGRITY

Core Oceanography

While not being an indicator for the CO in their own right, core oceanographic data are considered essential for monitoring the ANAOI because they provide background environmental context for the ecosystem. Once this information is available, researchers can evaluate natural variability and objectively assess changes that are occurring in the ecosystem. Participants suggested using an ocean observatory mooring to collect oceanographic data, as this tool can measure a variety of parameters such as temperature, salinity, currents, thickness of leads and pressure ridges, ice motion, etc. Ocean observatories can also be equipped with other instruments such as ambient sound recorders, and are an important tool for long-term data collection.

Benthic Habitat Distribution

Benthic habitat distribution provides important baseline information that can be used for assessing changes within the ANAOI ecosystem. Changes in the distribution of benthic habitats can also provide information on anthropogenic disturbances, such as grounding, dredging, and anchoring. Participants agreed that benthic habitat distribution should be included as an important indicator for monitoring the ANAOI.

Under-Ice, Ice-Associated and Open-Water Biota

Under ice biota, ice associated biota, and open-water biota were all identified as important indicators for monitoring the ANAOI, as they relate to ecosystem productivity (e.g., algae productivity can provide

an indication of the timing of sea-ice break-up). Participants agreed that these indicators should be measured using a combination of different methods, such as an ocean observatory, sediment traps, remote sensing, moorings, gliders (for ice associated biota), and biomarkers. Combining a suite of monitoring methods for collecting data on these indicators will be important because each method to collect the data will have associated drawbacks (e.g., remote sensing has high upfront costs and images can be disrupted by cloud cover, sediment traps are not always representative of what is actually present in the ecosystem).

Biodiversity

Biodiversity was added as an important indicator for monitoring the ANAOI, as it can provide a good indication of overall ecosystem health. Biodiversity can be measured using a suite of biomarkers. A participant stressed the importance of using northern community members to collect water samples from flaw leads, to measure lower trophic level biodiversity in the ANAOI. Community members expressed their interest in helping with the monitoring program and would like this point to be acknowledged in the SAR.

MARINE PRODUCTIVITY

Concentration of Nutrients

Nutrient concentrations were added as a valuable indicator for monitoring the ANAOI, as it measures the productive capacity of the ecosystem. A participant stated that budgets related to nutrient parameters can be an important indicator and that sampling is fairly simple. Nutrient concentration does not need to be measured frequently and community members could collect nutrient data using small boats and other local equipment. A suggestion was made to monitor ecosystem productivity; however, participants agreed not to incorporate this indicator into the monitoring plan for the ANAOI, as nutrient concentrations can provide very useful information on their own, and the costs associated with measuring productivity are very high (e.g., high cost of remote sensing).

Benthic Community Composition and Abundance

Benthic community composition (presence/absence) and abundance was added as a valuable indicator for monitoring the ANAOI, as this indicator provides important baseline information for the ANAOI ecosystem as well as information on overall ecosystem health, when integrated with oceanographic data.

PREY SPECIES

Offshore Fish Characteristics

Offshore fish characteristics (including community composition, structure, function, and energetics) were considered to be an important indicator for monitoring the ANAOI. Offshore fish monitoring should be both vessel based and community based. For community based monitoring, community members could monitor this indicator by monitoring bird diets (photography and observations) because birds forage within a 30 km radius of their colonies. Data collected from bird foraging observations are also important as it can provide information about feeding preferences and diet shifts, which are a key component of the ANAOI ecosystem. It was also proposed to monitor offshore fishes by analyzing the stomach contents of seals, Beluga, and Polar Bear. Vessel-based research was proposed as an important method for monitoring offshore fish characteristics because this method would be more sensitive to environmental changes and could provide important information on fish size.

Inshore Fish Characteristics

Inshore fish characteristics (including community composition, structure, function, and energetics) were added as an important indicator for monitoring the ANAOI. The fish species targeted for data collection will be determined once more research in the area is conducted. Paulatuk community members suggested locations for catching inshore fishes. They also expressed their interest in monitoring this indicator as they have an intimate knowledge of fish habitat use within the ANAOI. The cost of having local community members monitor inshore fishes would be high because of the need for specialized equipment, although this would be dependent on the target species.

Offshore and inshore fish energetics was added as another component to this indicator, as data on fish energetics can provide information on trophic relationships. The presence of odd species/odd looking individuals (e.g., hybrids, deformities, lesions, etc.) and the occurrence of odd behaviours (e.g., uncharacteristic life history changes) were also incorporated as another component of this indicator, as these characteristics can be closely linked to environmental disruptions. A Paulatuk community member described odd occurrences of Lake Trout (*Salvelinus namaycush*) in the Beaufort Sea (odd life history behavior).

Fish Diet Composition

Data on fish diet composition should be monitored in the ANAOI, as this can indicate whether fishes are consuming benthic or pelagic prey. Fish diet composition could be monitored by studying fish stomach contents and/or by analyzing stable isotopes, fatty acids, and contaminant tracers (which would also establish a baseline for contaminants such as mercury). A participant mentioned he has frozen fish samples in a freezer that can be further analyzed. Although this participant is currently conducting research on fish diet composition in the ANAOI, the hope is to organize local community and student programs to obtain data; although associated costs (e.g., gear) could be quite high. A participant re-iterated the importance of choosing key species to monitor the area as a means of lowering costs. A suggestion was made to monitor Arctic Char diets in the southern part of the Bay as a monitoring program has already been established for this species.

Capelin

Capelin presence/absence on ANAOI beaches should be monitored along with semi-quantitative abundance and the timing of Capelin on beaches, as the latter is more sensitive to environmental change. Capelin appear to be an important species for the ANAOI and last year researchers funded by the BREA program caught 464 Capelin off Bennet Point and are currently investigating their reproductive status. Paulatuk community members said they have caught Capelin off the shoreline of Cape Parry and that these fish are indeed spawning. Understanding why Capelin migrate to this area is valuable knowledge for understanding the ANAOI ecosystem, as Capelin serve as an important prey species for many animals that use the area (e.g., seabirds). A participant noted a possible positive correlation between Capelin spawning activity and the presence of seals and whales in these locations.

MARINE MAMMALS

Marine Mammal Characteristics

Marine mammal characteristics (including their presence/absence, timing and group composition) were identified as an important indicator for monitoring the ANAOI. Initially participants were concerned that these indicators may not be representative of the ANAOI ecosystem, as many marine mammals are migratory and spend a majority of their time outside the ANAOI boundaries. Despite this

drawback, participants felt that data obtained from this suite of indicators would provide important information for understanding the ANAOI ecosystem as a whole.

A suggestion was made to monitor the presence of odd mammals within the ANAOI; however, this suggestion was rejected as participants felt that data on marine mammal presence/absence, timing and group composition would provide sufficient information for monitoring the ANAOI ecosystem.

Marine Mammal Prey Items

Marine mammal prey composition was identified as a valuable indicator for monitoring the ANAOI and data on this indicator can be obtained by looking at marine mammal stomach contents (photographs from local community members or analysis of the stomach). In terms of sensitivity, this indicator was not deemed particularly sensitive for monitoring changes within the ANAOI; however, it provides important information on why marine mammals migrate to the area.

POLYNYAS AND ICE HABITATS

Ice Structures

Sea-ice provides important habitat for a number of species within the ANAOI boundaries (e.g., Polar Bear and Ringed Seal). Properties relating to sea-ice (e.g., thickness, ice structure) can provide important background information for the ANAOI ecosystem. A participant noted that data on ice structures could be derived from Radarsat and community observations. Although there is an ice component to the BREA program, data collection only occurs near Banks Island.

Ice Thickness

Participants expressed their desire for establishing local community monitoring programs for sea-ice thickness. Ice thickness measurements for Cape Parry were recorded in the past, but ceased when the Distant Early Warning Line (DEW; a series of military land-based installations with radar capability to monitor aircrafts, etc.) shut down. Nonetheless, 25 years of sea-ice thickness measurements for Cape Parry exist from to this program.

Ice Leads, Break-Up and Timing

Break-up and timing of sea-ice was added as a valuable indicator for monitoring the ANAOI. Ice leads are an important habitat feature for key species inhabiting the ANAOI (e.g., Polar Bear and Ringed Seal) and the timing of sea-ice break-up can give researchers an indication of whether this area is favourable for these animals on an annual basis. A Paulatuk community member discussed the potential for establishing local programs for monitoring these indicators, as individuals from the Paulatuk area have extensive ice knowledge. Data for these indicators can also be obtained from the CIS, although the incorporation of both monitoring methods is important as data from CIS is not always reliable (e.g., unclear images caused by clouds).

A Paulatuk community member noted that sea-ice break-up has been occurring earlier every year in the ANAOI (and in the central Arctic region).

HUMAN IMPACTS

Some participants suggested monitoring vessel traffic in the ANAOI, although there was concern regarding the difficultly associated with monitoring smaller/personal boats (i.e., lack of reporting). It was eventually agreed that all anthropogenic underwater noise should be monitored rather than just noise associated with vessel traffic, as all noise has an impact on the ecosystem, and noise occurring outside of the ANAOI (e.g., boats traveling outside the ANAOI) can also be detected within the ANAOI

boundaries. Underwater noise could be monitored using an ocean observatory as well as short term hydrophone deployments. Underwater noise would have to be compared against natural variability and change (need for baseline data).

DRAFTING OF THE SCIENCE ADVISORY REPORT

Summary bullets were drafted for the SAR. They included a description of the key components of an effective indicator, the key components of an effective monitoring program, and caveats relating to the proposed indicators, protocols and strategies for the ANAOI. Participants discussed the level of detail that should be incorporated into the SAR. They agreed that the SAR should only include concise summary information useful to managers, whereas the detailed scientific background relating to indicators, protocols and strategies should be reserved for the Research Document.

OTHER CONSIDERATIONS

KELP BEDS

Various participants expressed their desire to incorporate kelp beds as an indicator for monitoring the ANAOI. As not a lot is known regarding the location of kelp beds (although some community members said they have seen kelp washed up along the beach in Argo Bay after strong winds), participants agreed not to incorporate this indicator for monitoring the Science CO but rather to consider kelp beds for the TK CO. Concern was also expressed regarding the sensitivity of kelp beds as an indicator.

SEABIRDS

A migratory bird sanctuary (MBS) is located at Cape Parry. Participants discussed the importance of incorporating birds as a monitoring indicator for the ANAOI; however, after careful consideration, this idea was rejected, as birds are not in the jurisdiction of DFO (birds are protected and monitored by Environment Canada; EC) and Science advice regarding appropriate indicators, strategies and protocols would need to be developed by subject matter experts. It was further explained that EC is extremely interested in integrating a monitoring program with DFO Science. An integrated program with DFO and EC is key for representatively monitoring the ANAOI; however, until further arrangements are made, bird diet observations will be the only bird related indicator identified for the SAR.

POLAR BEAR

Although participants identified Polar Bear as an important species within the ANAOI, they agreed to exclude them from the list of indicators as Polar Bears are not within the jurisdiction of DFO and there were no subject matter experts at the meeting.

CONCLUDING REMARKS

All participants agreed that each of the selected indicators should be monitored in order to representatively evaluate whether the CO for the Cape Parry priority area is being met. Participants believe that the suggested indicators meet all the criteria of "effective indicators" outlined in the SAR. A conscious effort was made to exclude monitoring options that did not meet these criteria. If further prioritization and/or a reduction in the number of indicators are required, further scientific input will be required. Participants further agreed that data analysis, along with dissemination of results to both local and scientific communities, is a key component for monitoring the ANAOI. The importance of developing community based monitoring to monitor the selected indicators was also stressed.

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APPENDIX 1: TERMS OF REFERENCE

Anguniaqvia Niqiqyuam Area of Interest: Monitoring Indicators, Protocols and Strategies

Regional Peer Review – Central and Arctic Region

February 19-21, 2014
Winnipeg, Manitoba

Chairpersons: Oksana Schimnowski and Kevin Hedges

Context

Under the Health of the Oceans initiative, Fisheries and Oceans Canada (DFO) Science is required to provide support and advice on Marine Protected Areas to DFO Oceans Management. Currently, this includes the identification of indicators, protocols and strategies that are to be incorporated into Marine Protected Area (MPA) monitoring plans. Indicators, protocols and strategies are intended to allow DFO to evaluate whether the regulatory conservation objectives (COs) are being met for an MPA. Darnley Bay is located in the western Canadian Arctic within the Beaufort Sea Large Ocean Management Area (LOMA) and the Inuvialuit Settlement Region (ISR). A portion of Darnley Bay was nominated as an Area of Interest and is called the Anguniaqvia Niqiqyuam Area of Interest (ANAOI). For the ANAOI, one of the conservation objectives is "to maintain the integrity of the marine environment offshore of the Cape Parry Migratory Bird Sanctuary (MBS) so that it is productive and allows for high trophic level feeding by ensuring that the Cape Parry polynyas and associated sea-ice habitat, and the role of key prey species (e.g., Arctic Cod), are not disrupted by human activities.". DFO Science has been asked to provide advice on indicators protocols and strategies to evaluate the Cape Parry conservation objective.

Selection of indicators and protocols for collection and analysis of data must be scientifically defensible.

Objectives

The objectives of the meeting are to

- Develop indicators, protocols and strategies that are appropriate for evaluating the Cape Parry conservation objective.
- Assess whether data have been collected for any of these indicators and if so whether these data can be used to provide base-line information for evaluating the Cape Parry conservation objective.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Documents

Participation

- Fisheries and Oceans Canada (DFO) (Science, Oceans Programs)
- Fisheries Joint Management Committee
- University of Manitoba
- Museum of Nature
- Community of Paulatuk

APPENDIX 2: MEETING AGENDA

Anguniaqvia Niqiqyuam Area of Interest: Monitoring Indicators, Protocols and Strategies

Regional Science Peer Review

Location: Freshwater Institute, Winnipeg, Large Seminar Room

Date: Wednesday February 19th to Friday February 21st

Chairs: Oksana Schimnowski / Kevin Hedges

WEDNESDAY, FEBRUARY 19TH

13:00 – 13:15 – Introduction and Review Terms of Reference (Chairs)

13:15 – 13:30 – Background for ANAOI (Joclyn Paulic / Leah Brown)

13:30 – 14:15 – Presentation of Research Document (Vanessa Grandmaison)

14:15 – 14:30 – Meeting Strategy (Chairs)

14:30 – 14:45 – Break

14:45 – 16:30 – Presentation of Indicator Case Studies, discussion

THURSDAY, FEBRUARY 20TH

9:00 – 9:15 – Introduction to Day 2, Review of Day 1 (Chairs)

9:15 – 10:30 – Review List and Priority of Indicators, discussion

10:30 – 10:45 – Break

10:45 – 12:00 – Discussion continued

12:00 – 13:00 – Lunch

13:00 – 14:30 – Discussion continued

14:30 – 14:45 – Break

14:45 – 16:30 – Discussion continued

FRIDAY, FEBRUARY 21ST

9:00 – 9:15 – Introduction to Day 3, Review of Days 1 and 2 (Chairs)

9:15 – 10:30 – Drafting and Review Science Advisory Report

10:30 – 10:45 – Break

10:45 – 12:00 – Continued drafting until complete

APPENDIX 3: LIST OF PARTICIPANTS

NAMES OF PARTICIPANTS	AFFILIATION
Leah Brown	Fisheries and Oceans Canada, Oceans Program
Vanessa Grandmaison (rapporteur)	Fisheries and Oceans Canada, Science
Noel Green	Paulatuk community member
Tony Green	Paulatuk community member
Lois Harwood	Fisheries and Oceans Canada, Science
Kevin Hedges (co-chair)	Fisheries and Oceans Canada, Science
Carie Hoover	Fisheries and Oceans Canada, Science
Gerry Inglangasuk	Fisheries Joint Management Committee and Paulatuk community member
Jim Johnson	Fisheries and Oceans Canada, Science
Lisa Loseto	Fisheries and Oceans Canada, Science
Darcy McNicholl	University of Manitoba, and Fisheries and Oceans Canada, Science
Humfrey Melling	Fisheries and Oceans Canada, Science
Christine Michel	Fisheries and Oceans Canada, Science
Andrea Niemi	Fisheries and Oceans Canada, Science
Sonja Ostertag	Fisheries and Oceans Canada, Science
Joclyn Paulic	Fisheries and Oceans Canada, Oceans Program
Jim Reist	Fisheries and Oceans Canada, Science
Oksana Schimnowski (co-chair)	Fisheries and Oceans Canada, Science
Wojciech Walkusz	Fisheries and Oceans Canada, Science